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Yoshizuru

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(54) **HORIZONTAL DOUBLE DISC SURFACE GRINDING MACHINE**

(71) Applicant: **DAISHO SEIKI CORPORATION**, Ikeda-shi (JP)

(72) Inventor: **Shoji Yoshizuru**, Ikeda (JP)

(73) Assignee: **DAISHO SEIKI CORPORATION**, Nishinomiya-shi (JP)

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B24B 7/06 (2006.01)

(52) **U.S. Cl.**
CPC ***B24B 7/17*** (2013.01); ***B24B 7/06*** (2013.01)

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USPC 451/184, 261, 262, 267, 245, 336, 51
See application file for complete search history.

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Primary Examiner — Robert Rose
(74) *Attorney, Agent, or Firm* — Kratz, Quintos & Hanson, LLP

(57) **ABSTRACT**

A horizontal double disc surface grinding machine of through field type wherein a plate work in vertical posture is induced between grinding wheels by V-belts and work guiding plates. A work falling prevention member is disposed in a work transfer area. The work falling prevention member is provided with an upper plate, a middle plate, and a lower plate, and the middle plate is inserted to a gap between V-belt single bodies.

2 Claims, 13 Drawing Sheets

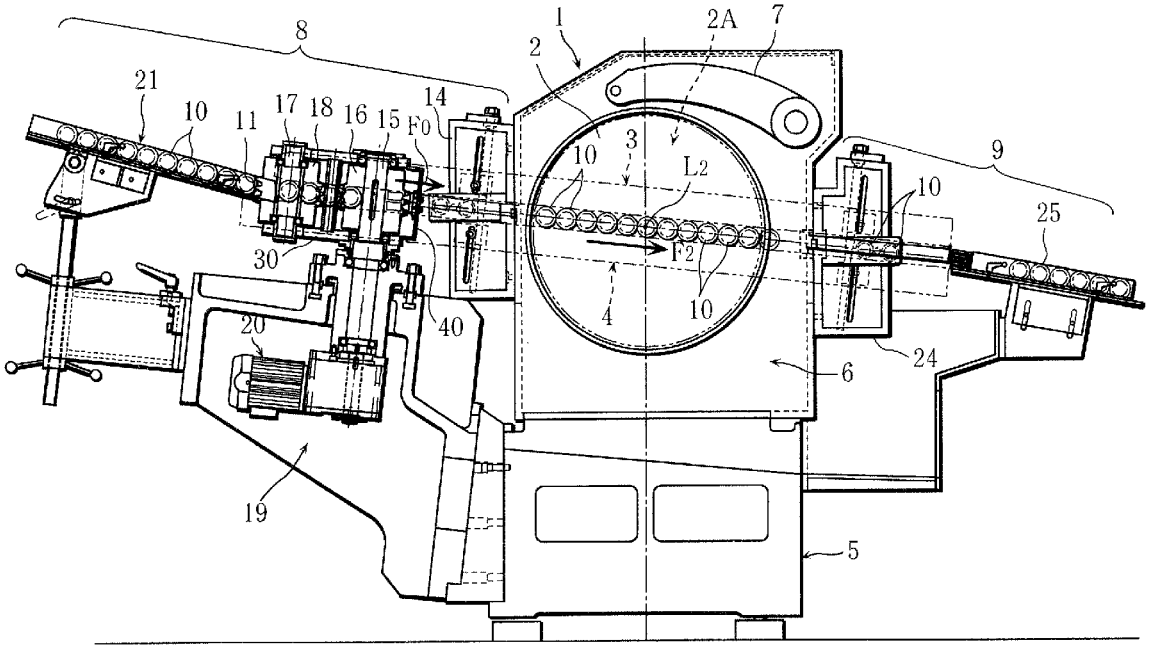
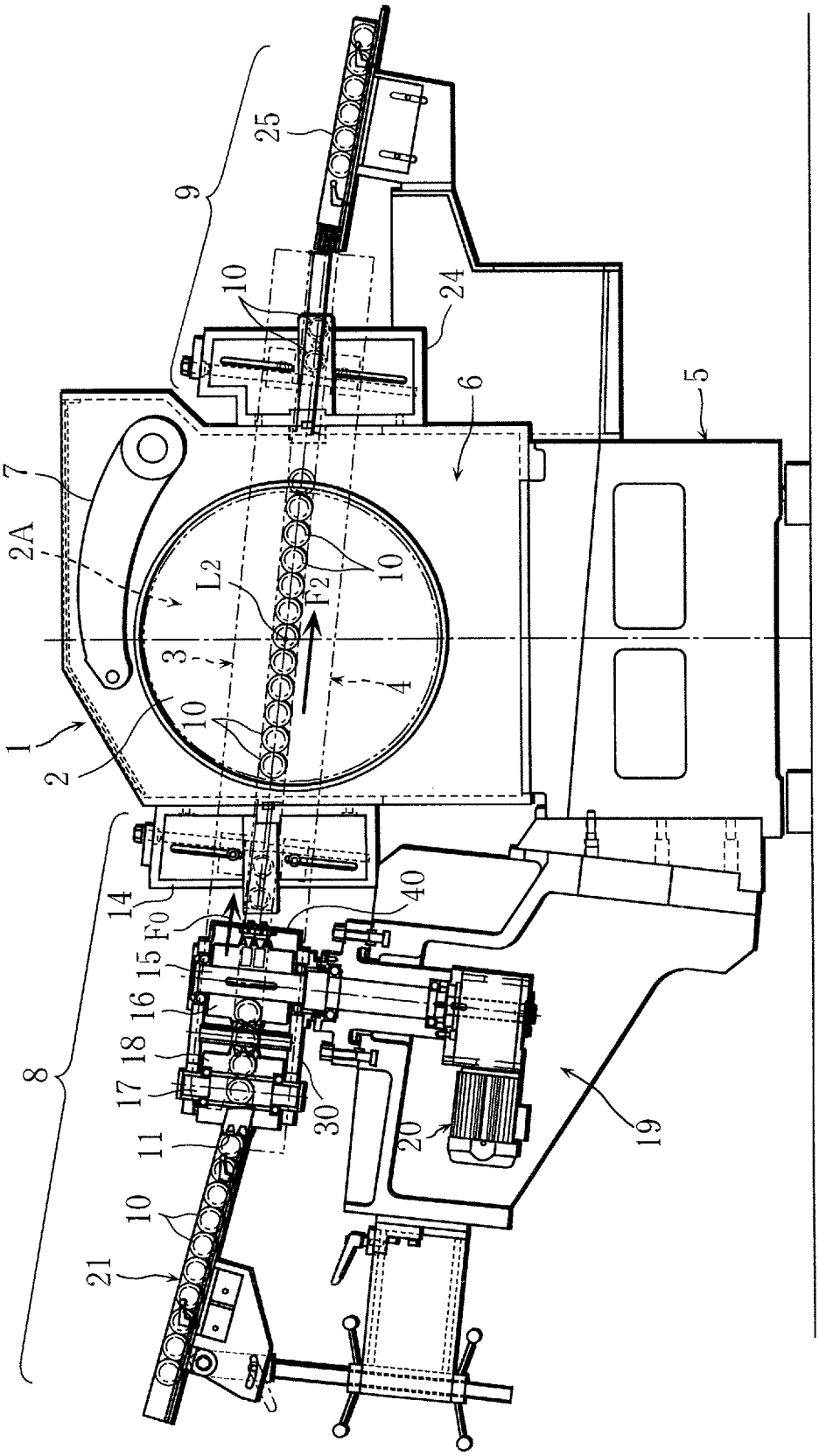


Fig. 1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16
18
17
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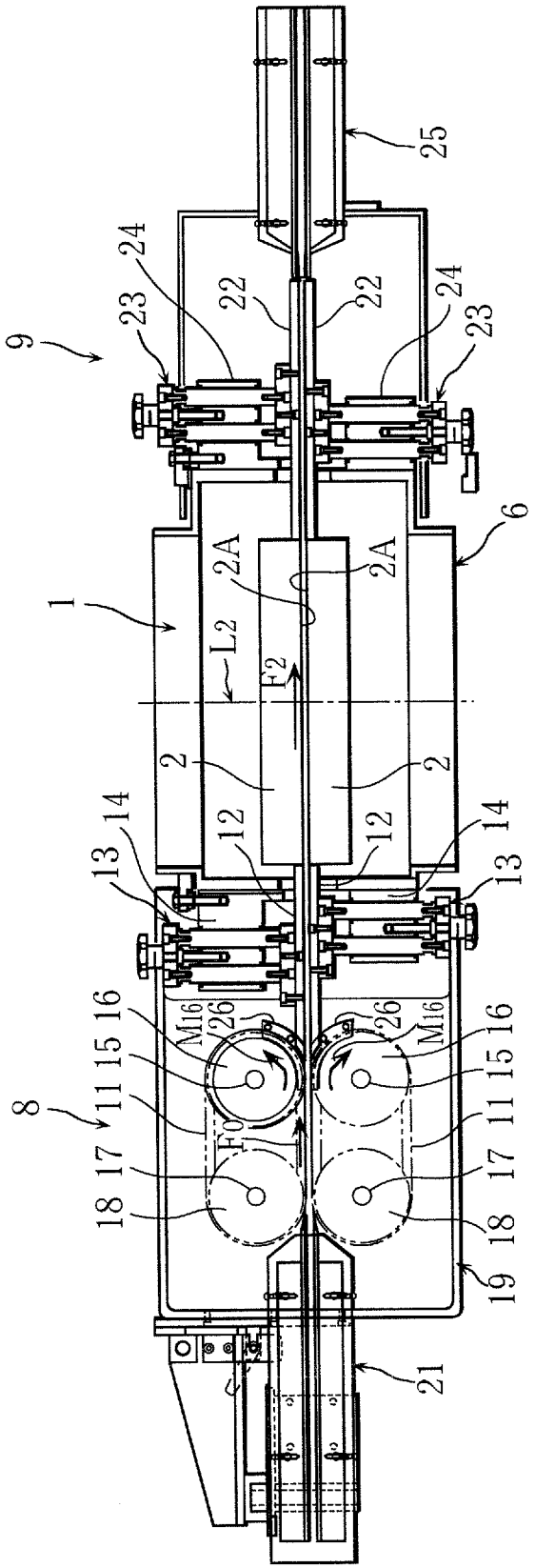
20
19
8
11
10
21

Fig. 2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L2
F2
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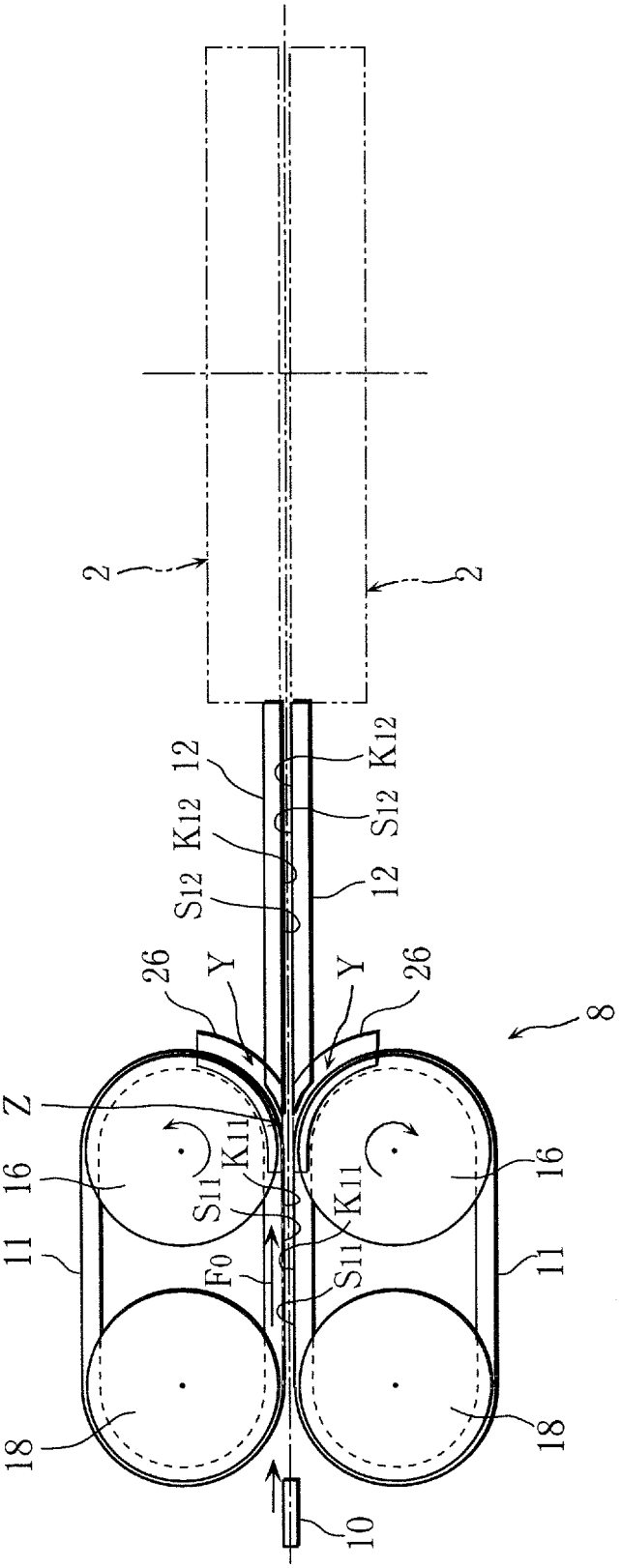
13
14
13
16
M16
26
26
M16
16
15
11
15
11
8
F0
17
17
18
18
19
21

Fig. 3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S12
K12
S12
12
26
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Y
26
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Z
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11
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K11
S11
F0
16
11
18
18
10

Fig. 4

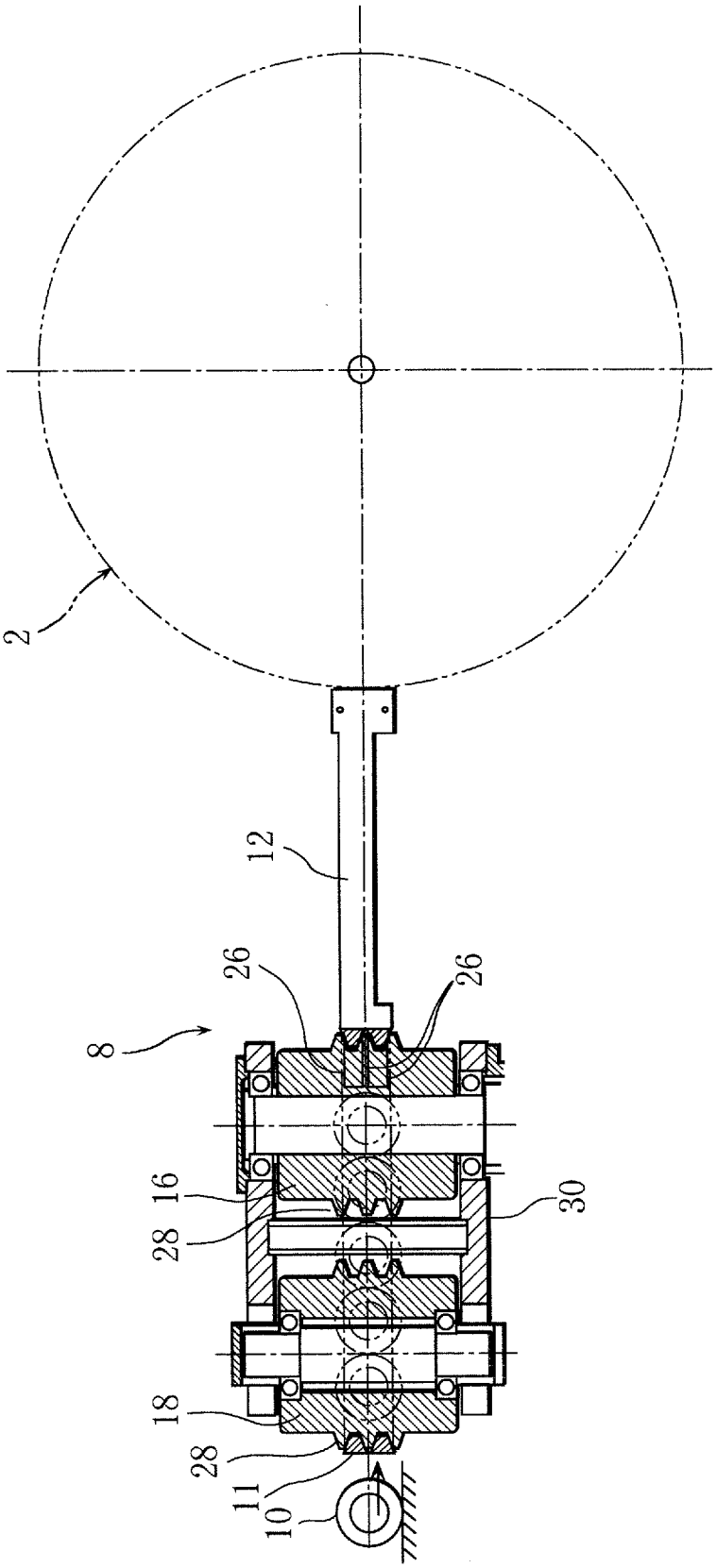
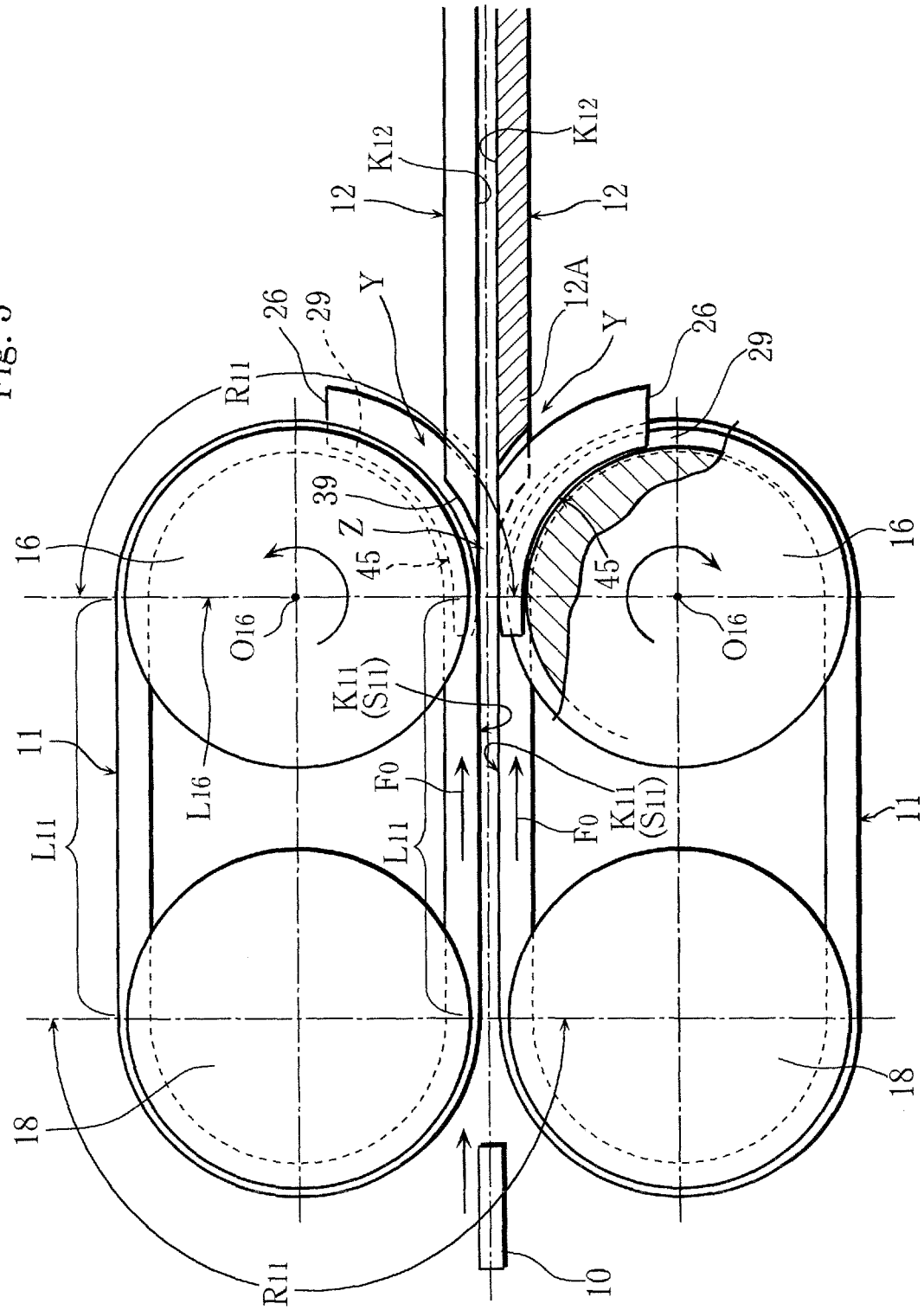


Fig. 5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K12
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12
12A
Y
Y
26
29
26
29
R11
39
Z
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45
16
16
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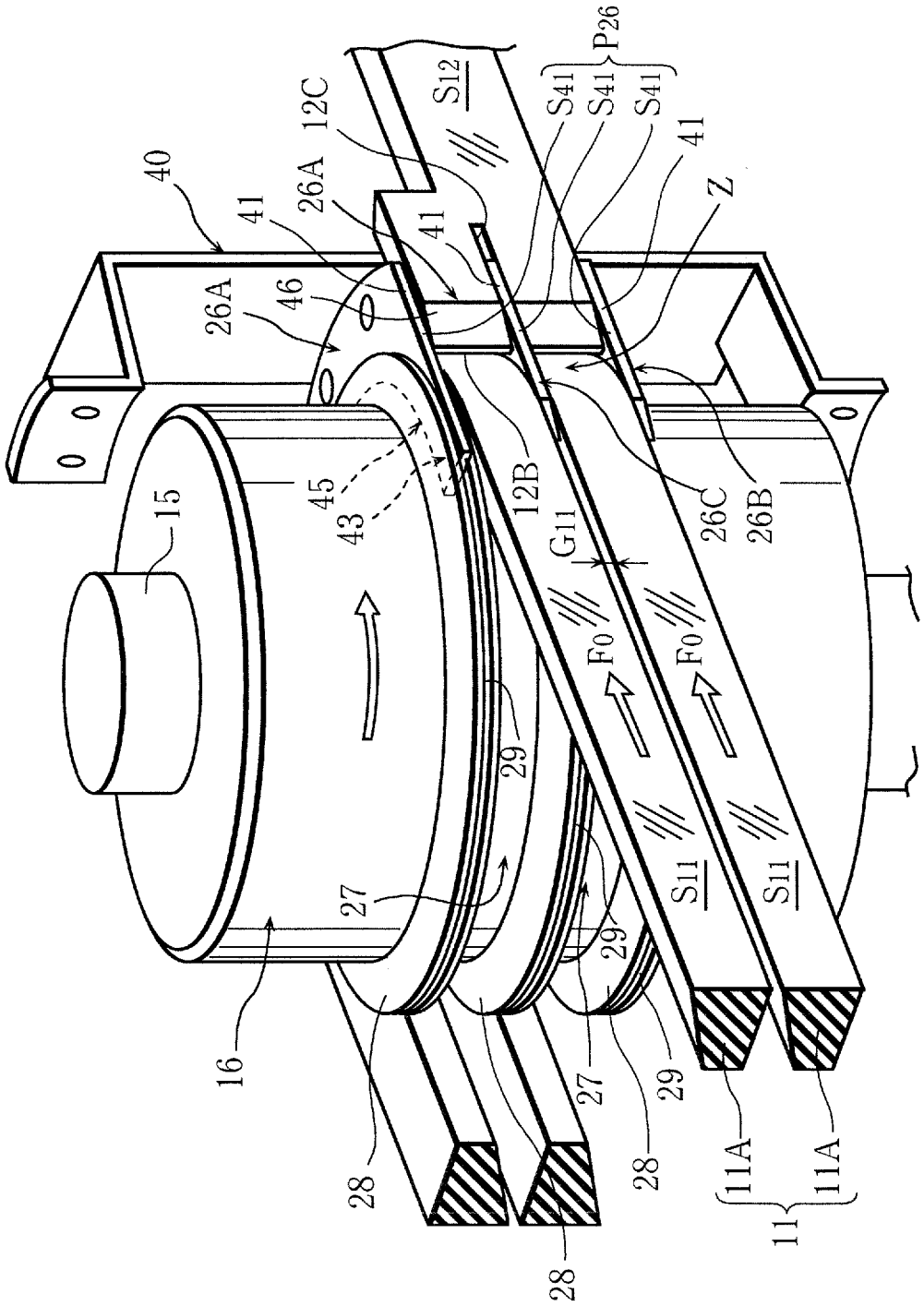
O16
K11
(S11)
K11
(S11)
F0
F0
11
11
L11
L11
L16
18
18
R11
10

Fig. 6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41
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S41
S41
S41
P26
41
Z
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26A
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12B
G11
26C
26B
F0
F0
29
27
S11
S11
16
28
28
28
27
29
29
11A
11A
11

Fig. 7

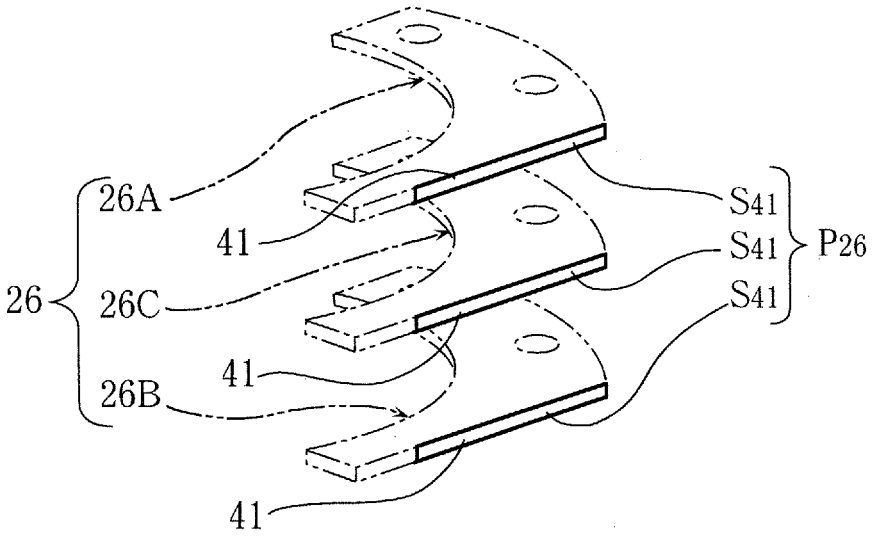


Fig. 8

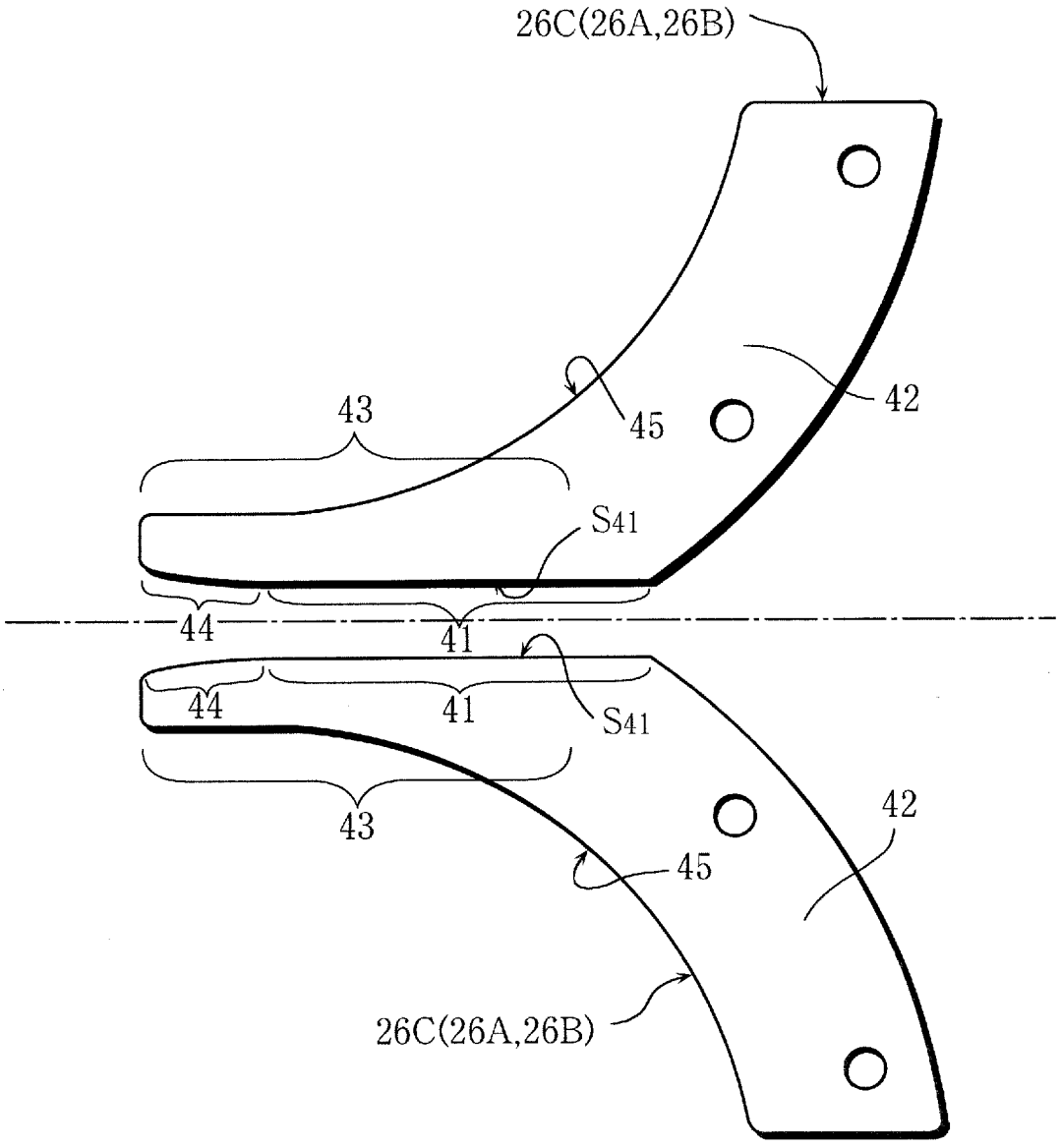


Fig. 9

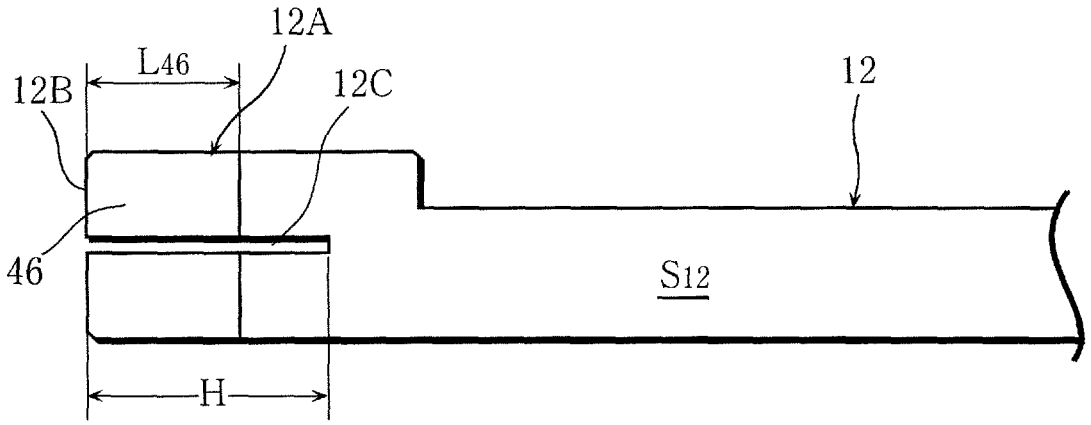


Fig. 10

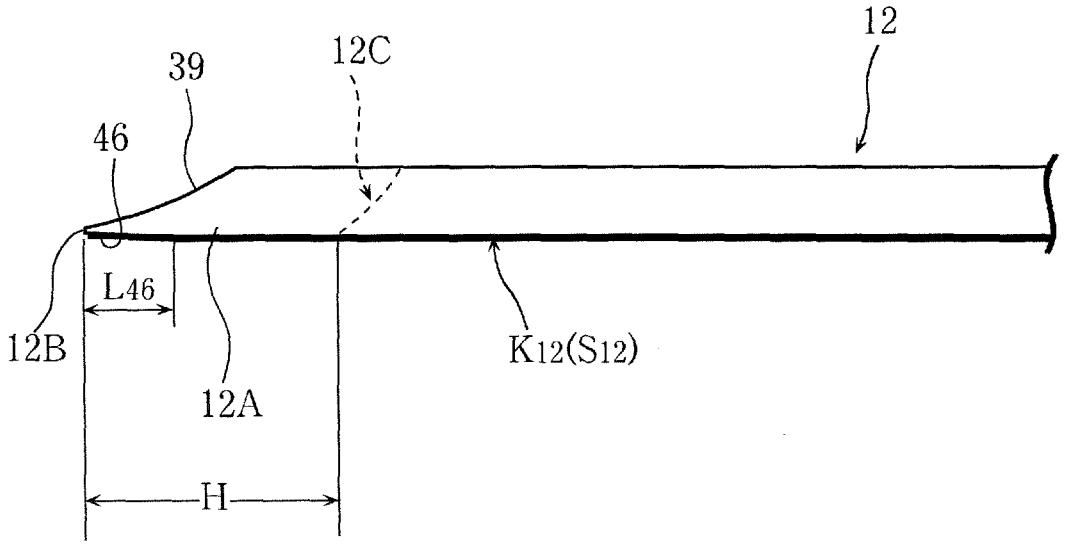
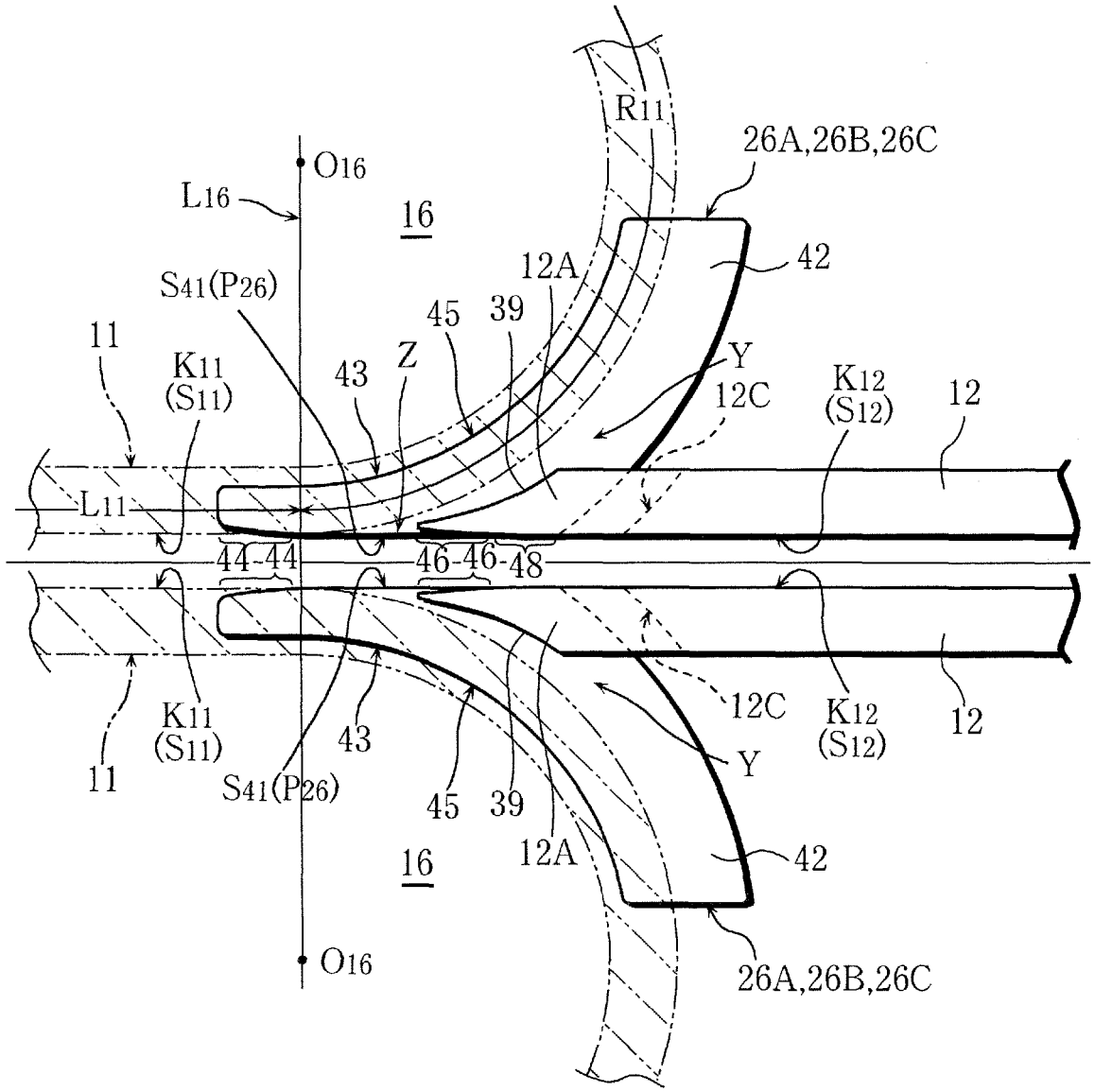


Fig. 11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O16
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K11
(S11)
43
Z
Y
12C
K12
(S12)
12
L11
44-44
46-46-48
12C
K12
(S12)
12
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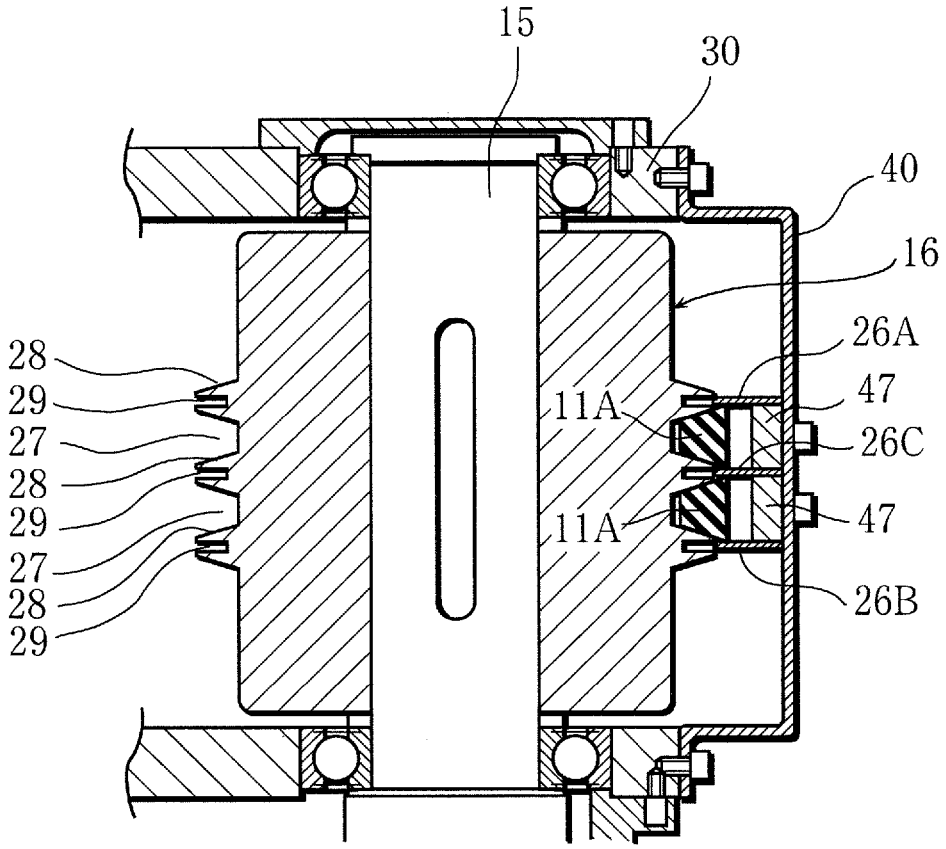
12A
16
42
O16
26A,26B,26C

Fig. 12


15
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26A
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11A
26C
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11A
26B
28
29
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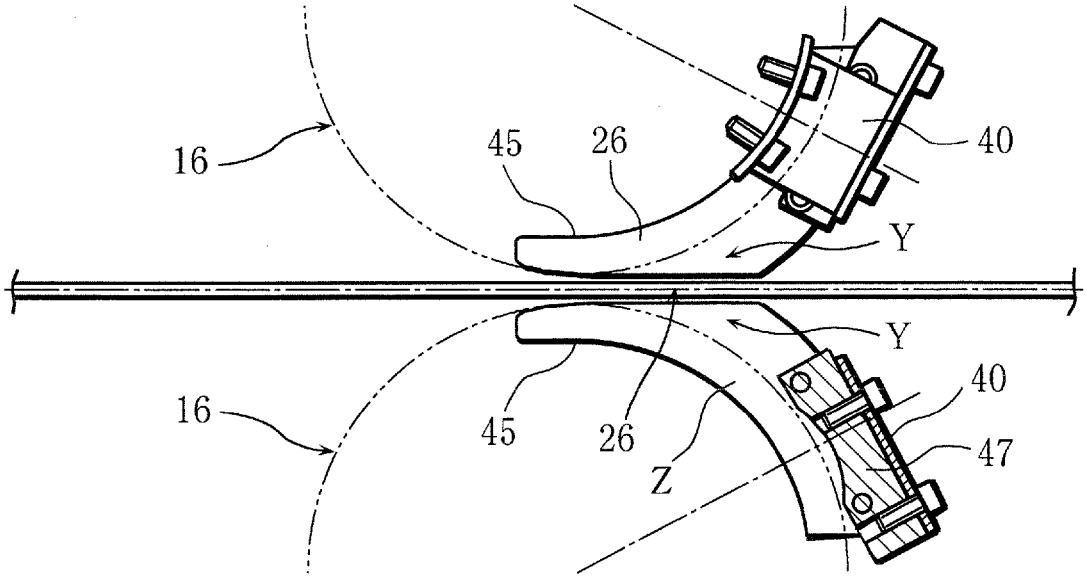
29

Fig. 13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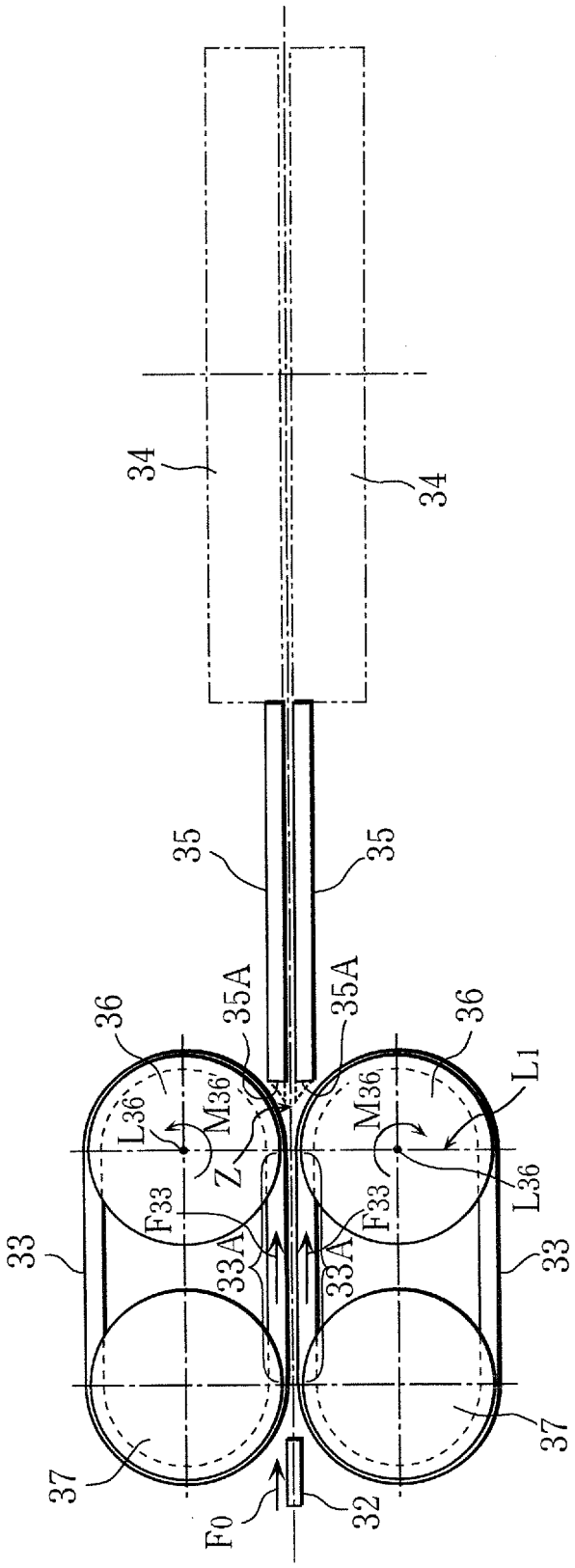
Y
Y
16
45
26
Z
40
47

Fig. 14
PRIOR ART



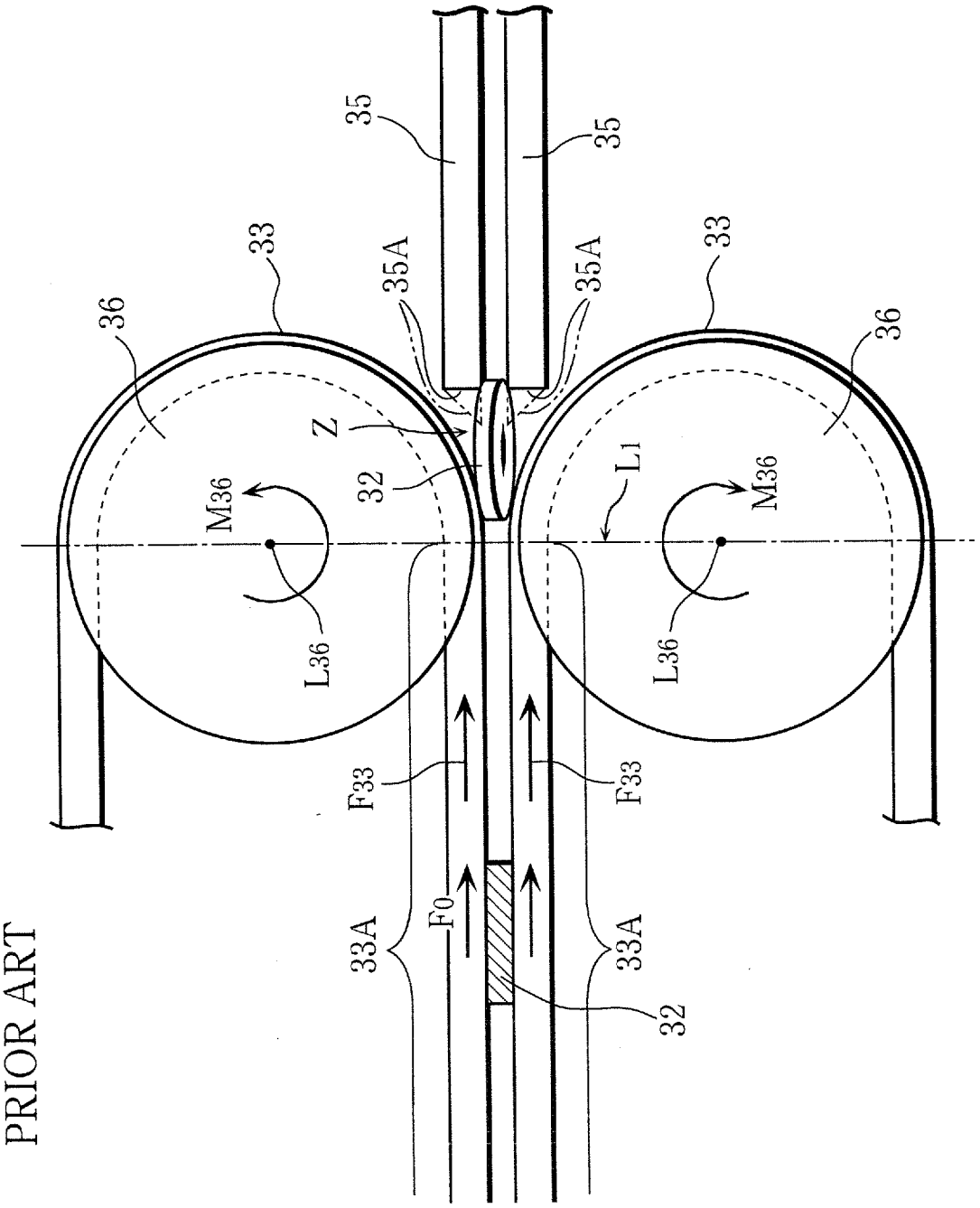


Fig. 15
PRIOR ART

HORIZONTAL DOUBLE DISC SURFACE GRINDING MACHINE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a horizontal double disc surface grinding machine.

2. Description of the Related Art

Conventionally, as a horizontal double disc surface grinding machine, a grinding machine of through-feed type, in which a work is made continuously and linearly pass between facing flat faces of grinding wheels, is known (refer to Japanese Patent Provisional Publication NO. S60-259364).

For example, a horizontal double disc surface grinding machine, a grinding machine of through-feed type as shown in a top view of FIG. **14** and an enlarged explanatory view of a principal portion of FIG. **15**, is known.

A pair of left and right endless V-belts, holding and giving feed F_0 to a plate work **32** such as a circular plate and a ring plate in vertical posture, and, a pair of left and right straight work guiding plates **35**, receiving the work **32** with the vertical posture on a downstream side of the V-belts **33** and guiding the work **32** between the grinding wheels **34**, are provided.

Each of the V-belts **33** is suspended on a driving roller **36** and a following roller **37**, and the V-belt **33** is moved in an arrow F_{33} direction by rotation of the driving roller **36** in an arrow M_{36} direction. As clearly shown in FIG. **14**, parallel running portions **33**A of the left and right V-belts **33** hold the work **32** and give the feed to the work **32** in the arrow F_{33} direction in mutually approximate state, the V-belts **33** are separated each other along the rotation of the rollers **36** after going over a straight line L_1 connecting axis points L_{36} of the rollers **36**.

Although the work guiding plate **35** is disposed with insertion within an approximately triangular area where the V-belts **33** are separated each other, a relatively large gap has to be formed between an upstream end **35**A of the work guiding plate **35** and the V-belt **33** for the running of the V-belt **33**, dimensional tolerance of the V-belt **33**, vibration, etc. Therefore, a work transfer area Z from the V-belt **33** to the plate **35** is formed rather large in top view, the work **32** may be inclining and falling as shown in FIG. **15** in the transfer area Z (when the outline of the work **32** is small), stopped by the upstream end **35**A of the guiding plate **35**, and not transferred to the guiding plate **35** (this is called transfer anomaly in some cases).

When the above-mentioned transfer anomaly is generated, facility (the grinding machine) must be temporarily stopped, and working ratio of the facility is decreased. Further, in the case of the facility stop, although the work left between (the left and right) grinding wheels is ground again when the facility is re-started, working accuracy is not stable and working defects ratio is increased.

Therefore, it is an object of the present invention to provide a grinding machine in which the transfer from the V-belt to the guiding plate is conducted stably and smoothly (preventing the falling and stopping of the work) even if the work is small, the facility stop along the conventional transfer anomaly is prevented, working ratio of the facility is increased, and the defect generation ratio of the working accuracy is reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be described with reference to the accompanying drawings in which:

FIG. **1** is a side view with partial cross section showing an embodiment of the present invention;

FIG. **2** is a top view;

FIG. **3** is a schematic top view of a principal portion;

FIG. **4** is a schematic side view of a principal portion with partial cross section;

FIG. **5** is an enlarged explanatory view of a principal portion;

FIG. **6** is a perspective view of a principal portion;

FIG. **7** is an explanatory perspective view of a principal portion;

FIG. **8** is an enlarged schematic top view of a principal portion;

FIG. **9** is a side view of a principal portion of a work guiding plate;

FIG. **10** is a top view of a principal portion of the work guiding plate;

FIG. **11** is an explanatory top view of construction of a principal portion;

FIG. **12** is a cross-sectional view of a principal portion;

FIG. **13** is a top view of a principal portion with partial cross section;

FIG. **14** is a top view showing a conventional example; and

FIG. **15** is an explanatory top view of a principal portion to explain problems of the conventional example.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention will now be described according to the embodiments shown in the drawings. FIG. **1** through FIG. **5** show an embodiment of the present invention.

FIG. **1** is a side view and FIG. **2** is a top view showing an embodiment of a horizontal double disc surface grinding machine. In FIG. **1** and FIG. **2**, a mark **1** represents a grinding machine main body, and a pair of circular (rotating) grinding wheels **2** is disposed as to freely rotate around a horizontal axis L_2 and driven to rotate by a driving means (not shown in figures).

A plate work **10**, passing between facing two flat faces **2**A of the pair of grinding wheels **2** linearly (in one straight direction) as an arrow F_2 with vertical posture, is ground on both faces simultaneously.

Marks **3** and **4** show an upper rail and a lower rail of plate metal disposed parallel with a vertical interval slightly larger than an outer diameter dimension of the work **10**, and, the upper and lower rails **3** and **4**, in the side view (shown in FIG. **1**), inserted to a gap between the flat faces **2**A of the grinding wheels **2**, go between the grinding wheels **2** slightly inclined downward to a downstream side on or near the axis L_2.

The work **10** is consecutively fed in the arrow F_2 direction (passing linearly), and vertical both sides of the work **10** are ground to flat faces. As described above, the present invention relates to a horizontal double disc surface grinding machine.

The grinding machine main body **1** is provided with a base portion **5** and a machine frame portion **6** disposed on the base portion **5**, and, the grinding wheels **2** are disposed in the machine frame portion **6**, and a dressing arm **7** is disposed for dressing the grinding wheels **2**.

Then, a work supplying device **8** to feed the work **10** serially to the grinding machine main body **1** is disposed on an upstream side (left side of FIG. **1**), and a work delivery device **9** to serially extract the work **10** ground by the grinding machine main body **1** is disposed on a downstream side (right side of FIG. **1**).

The work supplying device **8** is provided with a pair of left and right endless V-belts **11** to hold the work **10** in vertical

posture and give feed F_0, and a pair of left and right work guiding plates **12** to receive and induce the work **10** in vertical posture between (the flat faces **2**A of) the grinding wheels **2** on a downstream side of the V-belts **11**.

The position of each of the work guiding plates **12** in lateral direction can be changed by a left-right (position) adjusting mechanism **13**, and an interval dimension of the pair of work guiding plates **12** attached to a frame **14** is freely adjusted. The frame **14** is fixed to the machine frame portion **6**.

Each of the V-belts **11** is endlessly suspended onto a driving roller **16** fixed to an approximately vertical driving shaft **15** and a following roller **18** fixed to an approximately vertical following shaft **17**, and ellipse in top view.

A driving motor **20** is disposed on a sub base portion **19** fixed to an upstream side face of the base portion **5** of the grinding machine main body **1** to rotate the driving shaft **15** in an arrow M_{16} direction through a reducer.

A mark **21** represents a chute on work supplying side angle-adjustably attached to the sub base portion **19** as to incline downward to the downstream side, and the downstream end of the chute **21** is disposed to correspond to an interval of the following rollers **18** of the pair of V-belts **11**.

Next, the work delivery device **9** has a pair of left and right work extraction plates **22** to guide the work **10** in vertical posture just after the grinding to the right direction in FIG. **1** and FIG. **2** (namely, to the downstream side). The position of each of the work extraction plates **22** in lateral direction can be changed by a left-right (position) adjusting mechanism **23**, and an interval dimension of the pair of work extraction plates **22** attached to a frame **24** is freely adjusted. The frame **24** is fixed to the machine frame portion **6**.

And, a chute **25** on work extracting side inclining downward to the downstream side is attached to the downstream side of the work extraction plates **22** to be straight in top view.

FIG. **3** and FIG. **4** are showing enlarged principal portions of FIG. **2** and FIG. **1** respectively, and FIG. **5** is showing an enlarged principal portion of FIG. **3**.

As shown in FIG. **3**, FIG. **4**, FIG. **5**, FIG. **1**, and FIG. **2**, a work falling prevention member **26** is disposed in a work transfer area Z from the V-belt **11** to the work guiding plate **12** in the work supplying device **8** provided with the V-belts **11** and the work guiding plates **12**.

In the embodiment shown in FIG. **1** through FIG. **5** and FIG. **6** showing a perspective view of a principal portion, each of the left and right V-belts **11** is composed of two belt single bodies **11**A disposed parallel on upper and lower positions with a predetermined gap G_{11}.

Two concave peripheral grooves **27** for suspending V-belt are formed on each of the V-belt suspending rollers **16** and **18**, and the concave peripheral groove **27** is trapezoidal and approximately V-shape in cross section. And, three flanges **28** are protruding from each of the rollers **16** and **18** as outer brims, and the concave peripheral groove **27** is formed between the neighboring flanges **28** (refer to FIG. **6** and FIG. **12**).

Among the four rollers **16** and **18**, in the rollers **16** near the work transfer area Z, corresponding to the driving rollers **16** in figures, an escape slit portion **29** is formed from a peak of the flange **28** of steep trapezoidal cross section on a face at right angles with the axis (refer to FIG. **12**, FIG. **5**, and FIG. **6**).

And, each of the work guiding plates **12** is extended on an upstream end to come close to a curved outer peripheral face of the belt **11** suspended on the roller **16**, and formed into a concave portion **39** arc-shaped in top view as shown in FIG. **10**, FIG. **11**, and FIG. **5**. The dimension (range) along the work feeding direction of the work transfer area Z can be reduced by an extended portion **12**A extended as described above. And, each of the work guiding plates **12** is a belt plate wide on the upper and lower ends. A slit portion **12**C straight in side view is formed from an upstream end portion **12**B (of the extended portion **12**A) of each of the work guiding plates **12**.

Next, the work falling prevention member **26**, as shown in FIG. **7**, FIG. **12**, and FIG. **13**, has a parallel middle plate **26**C, an upper plate **26**A, and a lower plate **26**B, the middle plate **26**C, the upper plate **26**A, and the lower plate **26**B are united (unitized) with a spacer **47**, further, as shown in FIG. **12**, FIG. **13**, FIG. **1**, FIG. **4**, and FIG. **6**, the unit is fixed to a fixed holding frame **30** to hold the rollers **16** and **18** by an attachment member **40**. It is preferable to form the three plates **26**A, **26**B, and **26**C into the same configuration.

The middle plate **26**C of the work falling prevention member **26** is inserted to the gap G_{11} of the endless V-belts **11** from a reverse side of the work runway. And middle plate **26**C is inserted to the slit portion **12**C of the work guiding plate **12** from the reverse side of the work runway. And, the upper plate **26**A is disposed near an upper face of the extended portion **12**A of the work guiding plate **12**, and the lower plate **26**B is disposed near a lower face of the extended portion **12**A of the work guiding plate **12**.

In FIG. **7** and FIG. **8**, and in FIG. **6**, a work falling prevention guiding face P_{26}, on which the work falling prevention member **26** actually contacts the work **10**, is formed with end faces S_{41} of a straight portion **41** (refer to portions shown with solid lines in FIG. **7**) formed on an outline of the middle plate **26**C, the upper plate **26**A, and the lower plate **26**B.

Each of the plates **26**C, **26**A, and **26**B is composed of an arc plate base portion **42** and an extended portion **43** of which width dimension is gradually decreasing from the forth end portion of the arc plate base portion **42**. That is to say, the extended portion **43** (of which width dimension is gradually decreasing) is formed with the straight portion **41** straightly cut on an extended arc line of an arc peripheral line of the arc plate base portion **42** and a work interference escape line **44** arc-shaped or straight from the forth end of the straight portion **41**. The base portion **42** and the extended portion **43** have (continuous) inner peripheral end edges **45** of the same diameter.

The escape slit portion **29** is formed on the flange **28** of the roller **16** near the work transfer area Z among the V-belt suspension rollers **16** and **18** as described above. The inner peripheral end edge **45** of each of the plates **26**C, **26**A, and **26**B is inserted (under non contact state) to the escape slit portion **29** (as shown in FIG. **5**, FIG. **6**, and FIG. **11**).

As described above, the extended portion **43** can be reinforced by increased area (width dimension) of each of the extended portions **43** in top view by insertion of the inner peripheral end edge **45** of each of the plates **26**C, **26**A, and **26**B to the escape slit portion **29** of the flange **28** of the roller **16**.

The V-belt **11**, as shown in FIG. **5**, etc., is ellipse (athletic track shape) composed of parallel straight portions L_{11} and a pair of half-circle arc portions R_{11}.

The extended portions **43** of each of the plates **26**C, **26**A, and **26**B can be extended sufficiently long from a radial outer side of the V-belt **11** suspended on the roller **16** and from a wedge-shaped corner portion Y on the reverse side (of the work runway) of the work guiding plate **12** as to reach for the straight portion L_{11}, or overlap with the straight portion L_{11} for a small dimension.

The work falling prevention member **26** is described further in detail. The work falling prevention guiding face P_{26} of the work falling prevention member **26** connects a work hold-

ing line K_{11} composed of a pressing face S_{11} on which the V-belt **11** presses the work **10** and gives the feed F_0 and straight in top view, and a guiding line K_{12} composed of a sliding face S_{12} on which the work guiding plate **12** slides on the work **10** and straight in top view to be in a straight line in top view (refer to FIG. **6**, FIG. **11**, etc.).

In other words, the work falling prevention member **26** is provided with the work falling prevention guiding face P_{26} which connects the straight work holding line K_{11} and the straight guiding line K_{12} as to be in a straight line in top view. Therefore, the work falling prevention guiding face P_{26} is straight in top view, and composed of the end faces S_{41} of the upper plate **26**A, the middle plate **26**C, and the lower plate **26**B. The above-mentioned straight portions **41** overlap in top view to form a straight line, the straight line K_{11} on the upstream side and the straight line K_{12} on the downstream side are connected to form a straight line as a whole, and smooth feed of the work **10** is realized (without falling and hitching).

In the top view of FIG. **5**, the extended portion **43** of the work falling prevention member **26** exists beyond a straight line L_{16} connecting axis points O_{16} of the rollers **16** from the downstream side. That is to say, a part of the straight portion L_{11} of the V-belt **11** and a part of the extended portion **43** overlap in top view. Therefore, the work **10** is smoothly transferred and guided from the downstream end of the pressing face S_{11} (work holding line K_{11}) to hold the work **10** to the guiding face P_{26} (end face S_{41}) of the work falling prevention member **26**.

As shown in FIG. **8** and FIG. **11**, the work **10** is prevented from hitching to the forth end of the extended portion **43** by forming the work interference escape line **44** on the forth end of the extended portion **43**.

And, as shown in FIG. **9** and FIG. **10**, a sloped face **46** of a small dimension L_{46} is formed from the upstream end portion **12**B in the obverse side (sliding face S_{12} side) of the work guiding plate **12** forming the runway of the work **10**, the length dimension L_{46} of the sloped face **46** is set to be smaller than a depth dimension H of the slit portion **12**C, and each of the plates **26**A, **26**C, and **26**B of the work falling prevention member **26** is deeply inserted to the slit portion **12**C (refer to FIG. **6** and FIG. **11**).

With this construction of deep insertion, an overlapping portion **48** of straight lines in top view is formed as shown in FIG. **11**, and the work **10** is transferred very smoothly from the straight portion **41** of the work falling prevention member **26** to the sliding face S_{12} (guiding line K_{12}) of the work guiding plate **12**.

As described above, the downstream end portion of the straight portion L_{11} of the V-belt **11** and the end edge on the work runway side of each of the plates **26**A, **26**C, and **26**B of the work falling prevention member **26** form an overlapping portion, further, the end edge on the work runway side of each of the plates **26**A, **26**C, and **26**B of the work falling prevention member **26** and the extended portion **12**A of the work guiding plate **12** form the overlapping portion **48**.

The work **10** ground by the horizontal double disc surface grinding machine of the present invention, a piston ring, a bearing race, a valve seat, and other various things not restricted to circular and ring, may be polygonal, ellipse, etc. And, The V-belt single bodies **11**A may be three or more. In this case, the number of the plates **26**A, **26**C, and **26**B is four or more. Especially, the number of the middle plates **26**C inserted to the gap G_{11} between the V-belt single bodies **11**A may be increased to 2, 3, or more.

In the present invention, falling of the work **10** in the work transfer area Z from the V-belt **11** to the work guiding plate **12** (as show in FIG. **15**) and accompanying hitching of the guiding plate **12** to the upstream end portion can be prevented, conventional generation of facility halt can be remarkably reduced, and facility working time is improved because in a horizontal double disc surface grinding machine of through-feed type wherein the plate work **10** in vertical posture is induced between the grinding wheels **2** by the V-belts **11** and the work guiding plates **12**, the work falling prevention member **26** is disposed in the work transfer area Z from the V-belt **11** to the work guiding plate **12**. Further, defect in working accuracy generated along the facility halt can be reduced.

And, left and right side faces of work runway can be formed straight in top view without interval, the work **10** can be serially fed between the flat faces of the grinding wheels **2** smoothly and keeping normal posture without stopping and falling (even in a case of very small work **10**) because in a horizontal double disc surface grinding machine of through-feed type provided with the pair of endless V-belts **11**, holding the plate work **10** in vertical posture on left and right and giving feed F.sub.0, and the pair of work guiding plates **12**, receiving and guiding the work **10** in vertical posture between grinding wheels **2**, the work falling prevention member **26** is disposed in the work transfer area Z from the V-belt **11** to the work guiding plate **12**, and, the work falling prevention member **26** is provided with the work falling prevention guiding face P.sub.26 to connect the work holding line K.sub.11 straight in top view and formed with the pressing face S.sub.11 on which the V-belts **11** hold the work **10** to a guiding line K.sub.12 straight in top view and formed with the sliding face S.sub.12 on which the work guiding plate **12** slides on the work **10**.

Therefore, conventional generation of facility halt can be remarkably reduced, and facility working time is improved. Further, defect in working accuracy generated along the facility halt can be reduced.

And, the works **10** of small to large dimensions can be certainly and smoothly fed to the grinding wheels side without falling and hitching because each of the endless V-belts **11** is composed of plural units disposed on upper and lower positions to be parallel with the predetermined gap G_{11}, the slit portion **12**C is formed on each of the work guiding plates **12** from the upstream end portion **12**B, the work falling prevention member **26** has the middle plate **26**C, inserted to the gap G_{11} and the slit portion **12**C, and the upper plate **26**A and the lower plate **26**B disposed near the upper face and the lower face of the V-belt **11** respectively and having the same configuration as the middle plate **26**C, and, the work falling prevention guiding face P_{26} is composed of end faces S_{41} of the straight portions **41** formed of a part of outlines of the middle plate **26**C, the upper plate **26**A, and the lower plate **26**B. Further, the work **10** can be serially transferred from the V-belt **11** to the work falling prevention guiding face P_{26}, further to the work guiding plate **12** extremely smoothly, and hitching and falling of the work **10** can be certainly prevented.

And, even if the work **10** collides with the upstream end portion of the extended portion **43**, the extended portion **43** is not easily deformed, interference with the V-belt **11** is prevented, and the work **10** is fed to the grinding wheels **2** with stable normal posture for a long operation period because on the roller **16** near the work transfer area Z among the V-belt suspension rollers **16** and from which flanges **28** forming the concave peripheral groove **27** for V-belt suspension are protruding, the escape slit portion **29** is formed on the flange **28**, and areas of extended portions **43** of the middle plate **26**C, the upper plate **26**A, and the lower plate **26**B are increased in top view by partial insertion of the middle plate **26**C, the upper plate **26**A, and the lower plate **26**B to the escape slit portions

29 to reinforce the extended portions **43**. Especially, the extended portion **43** can be extended until overlapped with the straight portion L_{11} of the V-belt **11**, the transfer from the V-belt **11** to the work falling prevention member **26** is made certain and smooth.

While preferred embodiments of the present invention have been described in this specification, it is to be understood that the invention is illustrative and not restrictive, because various changes are possible within the spirit and indispensable features.

What is claimed is:

1. A horizontal double disc surface grinding machine of through-feed type provided with a pair of endless V-belts, holding a plate work in vertical posture on left and right and giving feed, and a pair of work guiding plates, receiving and guiding the work in vertical posture between grinding wheels, comprising a construction in which:

a work falling prevention member is disposed in a work transfer area from the V-belts to the work guiding plate;

the work falling prevention member is provided with a work falling prevention guiding face to connect a work holding line straight in top view and formed with a pressing face on which the V-belts hold the work to a guiding line straight in top view and formed with a sliding face on which the work guiding plate slides on the work;

each of the endless V-belts is composed of plural units disposed on upper and lower positions to be parallel with a predetermined gap;

a slit portion is formed on each of the work guiding plates from an upstream end portion;

the work falling prevention member has a middle plate, inserted to the gap and the slit portion, and an upper plate and a lower plate disposed near an upper face and a lower face of the V-belt respectively and having the same configuration as the middle plate; and

the work falling prevention guiding face is composed of end faces of straight portions formed of a part of outlines of the middle plate, the upper plate, and the lower plate.

2. A horizontal double disc surface grinding machine of through-feed type provided with a pair of endless V-belts, holding a plate work in vertical posture on left and right and giving feed, and a pair of work guiding plates, receiving and guiding the work in vertical posture between grinding wheels, comprising a construction in which:

a work falling prevention member is disposed in a work transfer area from the V-belts to the work guiding plate;

the work falling prevention member is provided with a work falling prevention guiding face to connect a work holding line straight in top view and formed with a pressing face on which the V-belts hold the work to a guiding line straight in top view and formed with a sliding face on which the work guiding plate slides on the work;

each of the endless V-belts is composed of plural units disposed on upper and lower positions to be parallel with a predetermined gap;

a slit portion is formed on each of the work guiding plates from an upstream end portion;

the work falling prevention member has a middle plate, inserted to the gap and the slit portion, and an upper plate and a lower plate disposed near an upper face and a lower face of the V-belt respectively and having the same configuration as the middle plate;

the work falling prevention guiding face is composed of end faces of straight portions formed of a part of outlines of the middle plate, the upper plate, and the lower plate; and

on a roller near the work transfer area among V-belt suspension rollers from which flanges forming a concave peripheral groove for V-belt suspension are protruding, an escape slit portion is formed on the flange, and areas of extended portions of the middle plate, the upper plate, and the lower plate are increased in top view by partial insertion of the middle plate, the upper plate, and the lower plate to the escape slit portions to reinforce the extended portions.

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